California Division of Mines and Geology
Fault Evaluation Report FER-173
Northern Newport-Inglewood Fault Zone,
Los Angeles County, California

by

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## INTRODUCTION

Potentially active faults located in Los Angeles County that are evaluated in this Fault Evaluation Report (FER) form the Newport-Inglewood fault zone and include, from southeast to northwest, the Reservoir Hill, Northeast Flank, Pickler, Cherry Hill, Avalon-Compton, Potrero, and Inglewood and associated faults (figure 1). These faults were zoned for Special Studies in 1976 in the Long Beach, Inglewood, Hollywood, and Beverly Hills 7.5-minute quadrangles (CDMG, 1976a, 1976b, 1976c, 1976d). Zoning for Special Studies in 1976 was based on the criterion of Quaternary-active faulting. Some faults in these quadrangles may not meet the current criteria for zoning and most of the zones appear to be unnecessarily wide. Those faults determined to be sufficiently active (Holocene) and well-defined are zoned by the State Geologist as directed by the Alquist-Priolo Special Studies Zones Act (Hart, 1985).

## SUMMARY OF AVAILABLE DATA

The Los Angeles County study area is characterized by a tectonic regime dominated by strike-slip faulting along elements of the San Andreas fault system. Topography in the study area is generally subdued, ranging from the flat floodplains of the Los Angeles River and Ballona Creek, to a series of low hills aligned along a general northwest trend. Elevations in the study area range from about 9 meters above sea level in the Los Angeles River to 156 meters in the Baldwin Hills. Development in the study area is extremely heavy; the earliest available aerial photographs (1927) do not predate the extensive oil field development along the Newport-Inglewood fault zone.

Predominant rock types exposed in the study area include lower Pleistocene San Pedro Formation, upper Pleistocene Lakewood Formation, and Holocene alluvium (Poland others, 1956; Poland and others, 1959; CDWR, 1961, 1968; Castle, 1960; DMG, 1982; Randell and others, 1983). Pliocene and Pleistocene marine and non-marine sedimentary rocks underlie the low hills which include (from south to north): Bixby Ranch Hill, Reservoir Hill, Signal Hill, Dominguez Hill, Rosecrans Hills, Baldwin Hills, and Cheviot (Beverly) Hills (figures 2a, 2b, 2c). The Los Angeles River and Ballona Creek have cut the Dominguez and Ballona gaps, respectively, during the last low stand of sea level (17-20 Ka) (Davis, 1981; Poland and others, 1956). These water gaps have subsequently been backfilled with Holocene alluvial floodplain deposits (CDWR, 1961, 1968).

The Newport-Inglewood fault zone extends for about 70 km from Newport mesa northwest to the Cheviot Hills along the western side of the Los Angeles Basin (Barrows, 1974). The Newport-Inglewood fault zone, which was originally zoned for Special Studies in 1976, is re-evaluated in two Fault Evaluation Reports (FER's). The Southern Newport-Inglewood fault zone was evaluated in FER-172. This FER will evaluate segments of the Newport-Inglewood fault zone in the Long Beach, Inglewood, Hollywood, Torrance, and Beverly Hills 7.5-minute quadrangles (figure 1).

The Newport-Inglewood fault zone consists of a series of northwest-trending, generally right-lateral strike-slip faults. Individual faults at or near the surface within the zone form short, discontinuous, generally left-stepping en echelon patterns. Associated northwest-to-west-trending, right stepping anticlinal folds, and numerous short subsidiary normal and reverse faults form what has variously been termed the Newport-Inglewood structural zone (Barrows, 1974), Newport-Inglewood zone of deformation (WCC, 1979), Newport-Inglewood uplift, or the Newport-Inglewood zone of flexure. For purposes of this report, the term Newport-Inglewood fault zone will be used because only those faults at or near the surface will be evaluated.

Harding (1973) considered the Newport-Inglewood fault zone to typify the wrench-tectonic style of deformation. Evidence for wrench deformation cited by Harding includes: (1) laterally offset fold axes and fold flanks; (2) horizontal slickensides observed along faults (well core data); (3) juxtaposed dissimilar stratigraphies; (4) variable nature of fault zone; (5) en echelon fold and fault pattern; (6) strike-slip genesis of associated secondary structures; and (7) parallel trend with documented wrench faults (i.e., San Andreas fault). The relatively small displacements of fold axes and the lack of a through-going fault in the sedimentary cover (Quaternary deposits?) indicated to Harding that the Newport-Inglewood fault zone is in the early stages of structural development (after Wilcox and others, 1973).

The magnitude of right-lateral offset along the Newport-Inglewood fault zone is not well known. Harding (1973) indicated that right-lateral strike-slip displacement of structural axes ranges from 180 to 760 meters. Hill (1971) reported that offsets of Miocene and Pliocene, and Pleistocene lithofacies seem to confirm right-lateral displacements of up to 3 km. Hazenbush and Allen (1958) suggested that the maximum horizontal deformation along the Newport-Inglewood fault zone may total more than 9-1/2 km since middle Miocene time. Woodward-Clyde Consultants (WCC, 1979) estimated that up to 3-1/2 km of right-lateral displacement has occurred along the fault zone since late Miocene time.

WCC (1979) calculated a slip-rate of about 0.5 mm/yr along the southern Newport-Inglewood fault zone, based on correlation of E-log data in the Seal Beach and Huntington Beach oil fields. The 0.5 mm/yr slip-rate represents fault displacement since late Miocene time, and it is not certain how this slip-rate relates to late Quaternary slip-rates. It was found that segments of the Newport-Inglewood fault zone in Huntington Beach, Seal Beach, Long Beach, and the Baldwin Hills are all characterized by long-term slip-rates of about 0.5 mm/yr (Guptill and Heath, 1981). It was also concluded that the ratio of horizontal slip to vertical slip was about 20:1 (WCC, 1979).

Clark and others (1984) assigned a preferred late Quaternary slip-rate of about 0.6 mm/yr along the North Branch fault in the Bolsa gap area. Clark and others emphasized that there were significant to major uncertainties involved with the estimates of maximum slip along the fault. It was also noted that the slip-rate is based on apparent vertical separation of the Holocene Bolsa aquifier; horizontal slip is not known.

RESERVOIR HILL FAULT

The Reservoir Hill fault, a N50°W-trending, right-lateral strike-slip fault, was zoned for special studies in 1976 based on mapping by Poland and others (1956) (figure 2a). Poland and others described the fault as a steeply northeast-dipping normal fault, based on oil well E-logs, and a northeast-facing scarp in late Pleistocene Lakewood Formation. The top of the lower Pleistocene San Pedro Formation is offset about 85 meters (down to the east), and the fault offsets late Pleistocene Lakewood Formation, according to Poland and others. The Reservoir Hill fault is thought to be a northwest continuation of the Seal Beach fault (Poland and others, 1956; Barrows, 1974; Bryant, 1985). Ingram (1968) did not map the Reservoir Hill fault in the Long Beach oil field, perhaps because the fault is located near the edge of the oil field. However, proprietary oil field data indicates that the Reservoir Hill fault is a major structural feature (D.D. Clarke, p.c., Sept. 1985). Ziony and others (1974) classified the Reservoir Hill fault as late Quaternary active.

Several site investigations along the Reservoir Hill fault have yielded conflicting data regarding the location and recency of faulting. A report for the Long Beach Community Hospital (Egner and others, 1974) reported no evidence of faulting and stated that it was doubtful that the northeast-facing scarp was fault related (locality 1, figure 2a).

Merrill (1977) mapped a northwest trending fault in late Pleistocene deposits, but stated that Holocene deposits were not offset. However, Merrill did not describe the Holocene deposits nor was the relationship between the fault and Holocene soil described (figure 2a, Table 1).

Johnson and Brown (1984) exposed evidence of a significant fault offsetting lower Pleistocene San Pedro Formation against upper Pleistocene Lakewood Formation (figures 2a, 4, Table 1). The main fault, located near the base of the northeast-facing scarp, trends N55°W and dips 87°SW, and has a component of down-to-the-east normal displacement. Although prior grading of the site had removed natural soils, the consultant concluded that the age of faulted Lakewood Formation deposits could be as young as 15,000 ybp. Sand dikes and sand boils exposed in the exploratory excavations indicate previous seismicity that is possibly associated with the Reservoir Hill fault. Johnson and Brown stated that the Reservoir Hill fault forms a ground water barrier in Holocene deposits in Alamitos gap (San Gabriel River floodplain; see Bryant, 1985).

Two site investigations at the southeast end of Reservoir Hill, which is a pressure ridge, exposed evidence of late Pleistocene offset along the Reservoir Hill fault (Scullin and Simon, 1984 and Rodine and McNamara, 1984) (figure 2a, Table 1). The Scullin and Simon investigation exposed fractures in pre-1933 fill that were on trend with the Reservoir Hill fault. These fractures conceivably could indicate surface fault rupture associated with the 1933 Long Beach earthquake. The fractures were not associated with faults in the natural deposits exposed. However, caving in the area where the faults were expected to be observed precluded detailed examination of the exposure. The consultant concluded that the fractures in fill were not surface fault rupture features.

The site investigation by Rodine and McNamara exposed the prinicpal trace of the Reservoir Hill fault (figure 2a, Table 1). The consultant concluded that the fault did not offset latest Pleistocene Lakewood Formation and the hazard of surface fault rupture was very low at the site. However, controversy exists regarding the identification of unfaulted material overlying the Reservoir Hill fault. D.D. Clarke, City of Long Beach geologist, contends that the unfaulted material is old fill derived from the Lakewood Formation and that it is possible that this fill could be offset. Thus, if the unfaulted unit has been misidentified, then evidence of a lack of Holocene faulting has not been demonstrated.

Permissive evidence of Holocene active faulting along the Reservoir Hill/Seal Beach fault was demonstrated at Landing Hill by Davis (1981) (refer to Bryant, 1985).

NORTHEAST FLANK AND PICKLER FAULTS

The Northeast Flank and Pickler faults were zoned for special studies in 1976 based on mapping by Poland and others (1956) (figure 2a). The Northeast Flank fault was inferred by Poland and others (1956), based on a northeast-facing scarp in late Pleistocene deposits along the northeast flank of Signal Hill (figure 2a) and unspecified water-well data. Poland and others assumed that the Northeast Flank fault was a steeply southwest-dipping fault, based on oil well data from Stolz (1943). Poland and others indicated that the base of the lower Pleistocene Silverado zone (San Pedro Formation) was vertically offset about 61 meters. Ingram (1968) mapped the fault as a steeply southwest-dipping reverse fault (figure 2a).

The Pickler fault (figure 2a) was first mapped by Stolz (1943), who inferred the fault as a south-dipping reverse fault. Poland and others (1956) mapped the fault based on a marked difference in the productivity of oil wells on either side of the fault and by a "known discontinuity in the principal water-bearing zones" (specific deposits not mentioned). Vertical displacement of the base of the San Pedro Formation was thought by Poland and others to be about 46 meters.

Ziony and others (1974) classified both the Northeast Flank and Pickler faults to be late Quaternary active.

CHERRY HILL FAULT

The Cherry Hill fault was zoned for special studies in 1976 based on the mapping of Poland and others (1956) (figure 2a). Poland and others stated that the Cherry Hill fault was the most clearly defined fault along the southern Newport-Inglewood fault zone. The Cherry Hill fault, first mapped by Stolz (1943), is considered by Poland and others to be a steeply northeast-dipping reverse fault. Poland and others mapped the Cherry Hill fault as offsetting upper Pleistocene deposits. Vertical displacement of Miocene beds is about 305 meters and vertical displacement of the base of the lower Pleistocene San Pedro Formation was reported to be about 61 meters, based on water-well data (Poland and others, 1956). Poland and others stated that vertical displacement of the late Pleistocene land surface totals as much as

33 meters (down to the southwest). An unspecified strike-slip component of offset occurs along the Cherry Hill fault, according to Poland and others. Ingram (1968) indicated that about 915 meters of right-lateral displacement occurs in Miocene sedimentary rocks at a depth of about 1220 meters (figure 2a).

Poland and others mapped the Cherry Hill fault as concealed across the floodplain of the Los Angeles River (Dominguez gap). Poland and others stated that a hydraulic discontinuity in lower Pleistocene deposits indicated faulting in Dominguez gap. However, their was no geologic evidence of faulting in recent (Holocene) deposits in Dominguez gap (Poland and others, 1956). Ziony and others (1974) classified the Cherry Hill fault as late Quaternary active.

Many site-specific fault investigations have been conducted in the general vicinity of the Cherry Hill fault since it was zoned in 1976, but most of these reports provide minimal information regarding the location of the fault because trenching was generally shallow. In addition, some near-surface units within the Lakewood Formation are very massive, and it is often difficult to distinguish between Lakewood Formation and younger colluvial deposits derived from the Lakewood Formation. Those investigations that have trenched very near or across the Cherry Hill fault have been plotted on figure 2a and summarized in Table 1.

Evans (1977) (included as appendix to Scullin, 1979-AP-1572) trenched across the mapped trace of the Cherry Hill fault and reported no evidence of faulting in late Pleistocene Lakewood Formation. Although the trench logs are too generalized to document lack of recent faulting, at station 0 + 76 in T-2, a step or offset in the contact between the Palos Verdes Sand member of the Lakewood Formation and overlying older alluvium (paleosol?) is suggestive of recent faulting (locality 2, figure 2a). This feature is along a N30°W trend with faults reported by Scullin (1979a) (locality 2, figure 2a).

Scullin (1979a) observed faults in late Pleistocene deposits along the trend of the Cherry Hill fault at locality 2 (figure 2a). Scullin did not recommend a building setback because he reported that upper Lakewood terrace deposits were not offset. Although the trench logs are very generalized, a significant amount of deformation in the upper Lakewood Formation (paleosol?) is apparent. In addition, the soil/colluvium unit significantly thickens across the fault, suggesting possible Holocene displacement.

Two other site investigations (Scullin, 1979c; Cousineau, 1983) indicate significant deformation of late Pleistocene deposits just east of the Cherry Hill fault (figure 2a, Table 1).

Dominguez Hill is a northwest-trending dome (locality 3, figure 2a). The Cherry Hill fault approaches Dominguez Hill from the southeast, and the southern part of the Avalon-Compton fault is located near the northwest flank of Dominguez Hill (figures 2a, 2b). Although reverse-oblique and strike-slip faulting have been reported at depth beneath Dominguez Hill (Grinsfelder, 1943; Graves, 1954), no through-going surface fault is known (Barrows, 1974). Barrows did observe minor south-dipping reverse faults in Plesitocene deposits near locality 4 (figure 2a). Although overlying soil deposits were not offset by these faults, the trend and style of faulting is consistent with a left-stepping, right-lateral strike-slip fault zone. Other minor reverse and oblique-slip faults also may exist within the Dominguez Hills area.

AVALON-COMPTON FAULT

The Avalon-Compton fault was zoned for special studies in 1976, based on mapping by Poland and others (1959) (figure 2b). This N24°W-trending fault was inferred by Poland and others, based on a west-facing scarp and an apparent vertical displacement of about 9 meters of lower Pleistocene deposits (water table levels in Silverado zone).

Ziony and others (1974) classified the Avalon-Compton fault as late Quaternary active.

A site investigation by Ruff and Hannan (1984) exposed evidence of a significant fault about 107 meters east of Poland and others' (1959) inferred fault (locality 5, figure 2b, figure 5, Table 1). The main fault (fault attitude N20°W90°) offsets late Pleistocene deposits identified as Lakewood Formation (figure 5). Major stratigraphic discontinuity across the principal fault and oblique and near-horizontal striations along the fault plane indicate a significant component of strike-slip displacement. Minor drag folds indicate a component of down-to-the-southwest, vertical displacement. Recency of faulting could not be established because natural soils had previously been removed due to grading. However, the consultant recommended a building setback.

ROSECRANS HILLS AREA

Ziony and others (1974) inferred a west-northwest-trending fault near Gardena, based on an 1896 topographic map and a description by Taber (1920, p. 140) (figure 2b). Taber described several closed depressions near the trend of this inferred fault. However, Taber (1920) did not provide a map of these features nor did he cite any other evidence for faulting. Smith (1978) concluded that this fault was based on indistinct, rather broad topographic features not necessarily related to faulting and is highly speculative.

Poland and others (1959) did not map a surface fault in late Pleistocene deposits in the Rosecran Hills area north of the Avalon-Compton fault (figure 2b). Poland and others indicated that a northwest-trending shear zone is located at depth beneath the Rosecrans Hills, but that beds of the lower Pliocene Repetto Formation do not appear to be offset. California Department of Water Resources (CDWR, 1961) stated that Pleistocene deposits are anticlinally folded in the Rosecrans Hills. The Rosecrans Hills area lies between two left-stepping segments of the Newport-Inglewood fault zone, the Avalon-Compton, and Potrero faults (figures 1, 2b).

POTRERO FAULT

The Potrero fault was zoned for special studies in 1976, based on mapping by Poland and others (1959) and Castle (1960) (figures 2b, 2d). Poland and others mapped the fault based on a 15-meter-high, southwest-facing scarp in late Pleistocene deposits, a 30-meter vertical displacement of lower Pleistocene deposits (Silverado zone), and a groundwater barrier in unspecified Pleistocene deposits. Castle's faults locally were based on Poland and others (1959), but significant differences in detail exist (figures 2b, 2d). Willis and Ballantyne (1943) mapped a N25°W-trending 82°SW-dipping fault, based on oil field data. At a depth of about 915 meters, Willis and Ballantyne reported that the Potrero fault vertically offsets Pliocene Repetto Formation about 82 meters (down to the southwest). However, Willis and

Ballantyne reported that the horizontal (strike-slip) component of offset along the Potrero fault was more signficant. The axis of the anticlinal fold in the Potrero oil field has been right-laterally offset at least 365 meters, and the predominant sense of offset indicated by striations along fault planes recovered in drill cores is horizontal.

Poland and others (1959) and Castle (1960) inferred several cross-faults that presumably offset the trace of the Potrero fault (figures 2b, 2d). These faults will be evaluated in a separate section in this Fault Evaluation Report.

Kew (1923) mapped the Potrero fault (figure 2d) that in general agrees with the location of the fault mapped by Poland and others (figure 2b) although Kew did not map the east-northeast-trending cross-faults that presumably offset the Potrero fault. Kew cited evidence of recent faulting along the Potrero fault that included: (1) Pleistocene deposits abruptly truncated against alluvium at "the old Centinela Spring" (locality 6, figure 2d); (2) right-lateral deflection of a drainage south of Centinela Creek (locality 7, figure 2d); (3) Centinela Creek has been beheaded. Kew stated that no evidence of historic surface fault rupture has been observed along the Potrero fault.

Two site-specific fault investigations have been conducted near the Potrero fault, but no evidence of faulting was reported (figure 2b, Table 1). Additional fault investigations within the SSZ's have been performed, but are not discussed in this FER.

EAST-NORTHEAST-TRENDING CROSS FAULTS

Poland and others (1959) and Castle (1960) mapped six cross-faults that they show offsetting the Potrero fault (figures 2b, 2d). These inferred faults were zoned for special studies in 1976, based primarily on Castle (1960). From south to north these faults are: Century Boulevard, Manchester Avenue, Inglewood Park Cemetery, Centinela Creek, Fairview Avenue, and Slauson Avenue faults (figure 2b). Poland and others (1959) inferred these faults, based on apparent offsets of the ground surface, linear drainages, and apparent offsets of the groundwater table. Water-well control for these faults is very poor, and most do not have substantiating geologic evidence (Poland and others, 1959).

Several site-specific investigations have been conducted across these cross-faults (figure 2b, Table 1). These investigations, though sometimes inadequate, have not verified the existence of any of the cross-faults.

INGLEWOOD FAULT ZONE

The Inglewood fault zone was zoned for special studies in 1976, based on mapping by Poland and others (1959) and Castle (1960) (figures 2b, 2c, 2d). The Inglewood fault zone is a complex, approximately N20°W-trending zone of strike-slip and normal faults. To facilitate discussion, the fault zone will be evaluated in three segments: faults south of the Baldwin Hills, faults within the Baldwin Hills, and faults north of the Baldwin Hills (figures 2b, 2c).

South of Baldwin Hills

Poland and others (1959) inferred the southern segment of the Inglewood fault zone (Townsite fault), based on topographic evidence (subtle southwest-facing break in slope), and an apparent 30-meter vertical displacement of the base of the lower Pleistocene San Pedro Formation (figure 2b). Willis and Ballantyne (1943) mapped the Townsite fault at depth and considered displacement to be primarily strike-slip with a reverse component, based on oil well data. Kew (1923) mapped a segment of the Inglewood fault zone (figure 2d) that corresponds in general to the fault mapped by Poland and others (1959) (figure 2b). Ziony and others (1974) do not depict this fault segment (figure 1).

Baldwin Hills Area

The Inglewood fault zone in the Baldwin Hills mapped by Castle (1960) is a complex, northwest-trending zone of normal and strike-slip faults (figures 2b, 2c). Poland and others (1959) stated that the Inglewood fault formed the east side of a graben that cuts across the center of the Baldwin Hills. Poland and others postulated that about 84 meters of vertical displacement has occurred along this fault, based on the apparent offset of the topographic surface. Most of the faults in the Baldwin Hills mapped by Poland and others were based on unpublished mapping by G.B. Moody (1935).

Driver (1943) considered the Inglewood fault to have a major strike-slip component of offset, based on the configuration of oil-producing horizons, near horizontal striae on fault planes observed in drill cores, and the apparent right-laterally offset northern slope of the Baldwin Hills.

Mapping by Castle and Yerkes (1976) along the Inglewood fault zone does not differ significantly with mapping by Castle (1960). Castle and Yerkes postulated that right-lateral strike-slip displacement along the Inglewood fault zone during Quaternary time may be as much as 610 meters. This displacement is based on the apparent right-lateral deflection of the northern front of the Baldwin Hills.

Numerous faults mapped by Castle (1960) in the Baldwin Hills were zoned for special studies in 1976 (figures 2b, 2c). Most of these faults are inferred and presumably are secondary in nature and are related to uplift and folding in the Baldwin Hills. Little is known about the style of faulting and magnitude of displacement of these features. Most of these faults were zoned in 1976 because they offset Pleistocene deposits, but none are known to have evidence of Holocene displacement. However, some faults mapped by Castle (1960) and Castle and Yerkes (1969), and zoned in 1976, have had historic surface rupture (figures 2b, 2d). Although most of these features are faults, Castle and Yerkes (1976) preferred to call them "earth cracks". These cracks are generally delineated by single or en echelon ruptures of the ground surface along fairly straight, northerly trends. Displacement along the cracks is generally dip-slip, although open fissures with no discernible displacements have been reported. Cumulative dip-slip displacements along cracks range from barely perceptible to approximately 17-1/2 cm (CDWR, 1964; Castle and Yerkes, 1976). Very minor components of left-lateral offset have been reported along some of the cracks (Castle and Yerkes, 1976). The most notable surface rupture event resulted in the failure of the Baldwin Hills dam on December 14, 1963 (CDWR, 1964). CDWR (1964) and Castle and Yerkes (1976) concluded that surface rupture associated with these faults and fault-like features is largely the result of subsidence caused by fluid withdrawal in the

Inglewood oil field. Site-specific fault investigations have not verified those faults away from the Inglewood fault zone that are not associated with fluid withdrawal (figure 2b, Table 1).

Faults North of Baldwin Hills

Poland and others (1959) mapped a N26°W-trending fault north of the Baldwin Hills that was zoned for special studies in 1976 (figure 2c). Poland and others mapped this northwest continuation of the Inglewood fault zone as concealed through the Ballona Creek floodplain (Ballona gap). Their interpretation was based on water-well data indicating vertical displacement of Pleistocene water-bearing deposits of about 60 meters. The down-to-the-east sense of offset is opposite to the displacement mapped in the Baldwin Hills. Poland and others indicated that the "50-foot gravel" horizon (early Holocene) is not offset along the fault (not a ground water barrier). North of Ballona Gap, Poland and others apparently inferred the surface trace of the fault based on topographic evidence in the Cheviot Hills. Poland and others inferred the Inglewood fault as offsetting late Pleistocene deposits in the area south of Olympic Drive (locality 8, figure 2c).

Crowder (1968) postulated that the Inglewood fault in the Cheviot Hills is a southwest-dipping normal fault, although the magnitude of displacement is not known. The Inglewood fault zone is quite close to the east-west-trending Santa Monica fault zone (figure 1), and it is assumed by this writer that the complexities associated with converging fault zones result in distributive, discontinuous faulting in the near surface along the Inglewood fault zone.

The Ballona Creek floodplain east of the Inglewood fault historically had been a marshland until dewatering operations began (Weber and others, 1982). Trench excavations by D. Moran (p.c., Oct. 1985) exposed carbonaceous deposits indicative of marshy conditions at locality 9 (figure 2b). Radiocarbon dates of carbonaceous deposits at depths of 2 meters and 2.7 meters were 2,000 ybp and 4,000 ybp, respectively. Thus, the westward flow of Ballona Creek has been impeded during the Holocene, possibly due to surface faulting along the Inglewood fault zone (Weber and others, 1982).

Two site specific fault investigations near the northern end of the Inglewood fault zone did not report evidence of late Pleistocene faulting (figure 2c, Table 1).

FAULT A

Poland and others (1959) mapped a west-northwest-trending fault along the northern front of the Baldwin Hills. This fault was also mapped by Castle (1960) and was zoned for special studies in 1976, based on Castle (1960) (figure 2b). The style of faulting and magnitude of displacement are not known for this fault. Castle (1960) and Poland and others (1959) depict this fault as offsetting Tertiary sedimentary rocks, but not alluvium.

Weber and others (1982) based all of their faults in the Baldwin Hills on Castle and Yerkes (1976), except for Fault A. Weber and others (1982) mapped this fault as offsetting Holocene alluvium at locality 10 (figure 2b). The fault mapped by Weber and others differs significantly in location from the fault mapped Poland and others (1959) and Castle (1960) (figure 2b).

FAULT B

A northwest-trending fault in Ballona Creek mapped by Castle (1960) was zoned for special studies in 1976 (figure 2b). Castle (1960) based the location of this fault on the anomalous presence of Pleistocene sands in the floodplain of Ballona Creek (locality 10, figure 2b) and apparent lithologic discontinuities in unspecified alluvium, based on water-well data. Ziony and others (1974) classified this fault as Holocene active, based on mapping by Castle (1960).

D. Moran (p.c. October 1985) currently is investigating the southeastern projection of Fault B at locality 9 (figure 2b) for the City of Los Angeles. No evidence of faulting was observed in 6,000-year-old alluvium, based on trench excavations. In addition, an approximately 10 1/2-meter-deep, 114-meter-long tunnel excavation exposed unfaulted late Pleistocene alluvium (D. Moran, p.c. October 1985; J. Kahle, p.c. October 1985). Moran (p.c. October 1985) stated that geomorphic evidence for this fault was generally vague southeast of the Pleistocene deposits at locality 10 and only vague tonal lineaments suggested the location of the fault (figure 2b).

INTERPRETATION OF AERIAL PHOTOGRAPHS AND FIELD OBSERVATIONS

Aerial photographic interpretation by this writer of faults in the Los Angeles County study area was accomplished using Fairchild aerial photos (C-113, 1927, scale 1:18,000; C-300, 1928, scale 1:18,000).

Field mapping in the study area is severely limited by intense development throughout almost all of the study area. Therefore, most of the interpretation of air photos was not field checked. The author spent about 1/2 day examining exposures of the Reservoir Hill fault at the Rodine and McNamara (1984) site (figures 2a, 3a). Observations of excavations were made by J. Kahle at the D. Moran site (locality 9, figure 2b). Results of air photo interpretation by this writer are summarized on figures 3a, 3c. The air photos also were reviewed by E. Hart, who largely verified the interpretations and provided additional observations.

RESERVIOR HILL, NORTHEAST FLANK, PICKLER, AND CHERRY HILL FAULTS

Faults in the Long Beach 7.5-minute quadrangle will be discussed together in order to better portray the signficant pattern of recent faulting (figure 3a). From southeast to northwest, the Reservoir Hill, Northeast Flank, and Cherry Hill faults form a left-stepping en echelon pattern of faulting characteristic of right-lateral strike-slip displacement (figure 3a). Reservoir Hill and Signal Hill are pressure ridges located between left-stepping segments of the Newport-Inglewood fault zone. These faults are associated with relatively broad warping of what Poland and others (1956, 1959) considered to be a late Pleistocene terrace surface, much of which is still preserved. Pleistocene deposits offset along these faults are soft and easily erodable; thus, the geomorphic expression of recently active faulting is generally quite subtle.

The Reservoir Hill fault is a northwest-trending fault that generally is moderately well-defined. The fault trace mapped by Poland and others (1956) and zoned in 1976 was generally verified by this writer (figures 2a, 3a). Geomorphic features indicative of recent faulting along the Reservoir Hill fault include a moderately well-defined, northeast-facing scarp in Pleistocene deposits, a linear trough, left-laterally deflected drainage (stream capture?), a possible right-laterally deflected drainage, and associated tonal lineaments in late Pleistocene deposits (figure 3a). Just southeast of the study area, this fault is associated with a linear trough, possible closed depression, and associated tonal lineaments in Holocene alluvium (refer to figure 3b of Bryant, 1985).

The Northeast Flank fault strikes northwest from the northwest side of Reservoir Hill and is located along the northeastern flank of Signal Hill (figure 3a). The ground surface along much of the Northeast Flank fault has been modified by oil field grading, based on air photo interpretation of 1927 and 1928 Fairchild air photos. However, the fault is delineated by a moderately defined, northeast-facing scarp that aligns with a southwest-facing scarp along the west side of Reservoir Hill (figure 3a). This writer could not verify the southeastern extent of the fault mapped by Poland and others (1956). To the northwest, the fault may bend west around the northern slope of Signal Hill, probably as a reverse fault (Pickler fault?) (locality 11, figure 3a). However, a well-defined, northwest-facing scarp along the trace of the Pickler fault was not observed by this writer, based on air photo interpretation.

The Cherry Hill fault is a moderately well-defined fault trending northwest from the west side of Signal Hill (figure 3a). The fault is delineated by a moderately well-defined, though somewhat dissected, southwest-facing scarp in late Pleistocene deposits (figure 3a). A right-laterally deflected drainage, closed depression(?), and associated tonal lineaments suggest latest Pleistocene to Holocene strike-slip faulting (figure 3a). The late Pleistocene terrace surface east of the fault has been warped and tilted eastward, suggesting that folding associated faulting has occurred, and is probably continuing to occur, along this segment of the Cherry Hill fault. A component of recent vertical displacement is suggested at locality 12 (figure 3a) where a terrace surface seems to be vertically offset (southwest side down). Near this location the Cherry Hill fault changes to a more northerly trend before it approaches late Holocene alluvium of the Los Angeles River floodplain (Dominguez gap) (figure 3c). The northwest continuation of the Cherry Hill fault is suggested by a wide zone of vague tonal lineaments in late Holocene alluvium across Dominguez gap (figure 3a). Associated geomorphic features were not observed in Dominguez gap, although it is not expected that ephemeral, fault-related geomorphic features would be preserved for any length of time in such a relatively high-energy/depositional environment.

AVALON-COMPTON, POTRERO, AND INGLEWOOD FAULTS

The pattern of left-stepping, en echelon strike-slip faults is consistent from the Cherry Hill fault to the Avalon-Compton fault (figures 1, 3a, 3b). Dominguez Hills, a compressional structure situated between two left-stepping segments of the Newport-Inglewood fault zone, is a broadly arched, late Pleistocene terrace surface (figure 3a). The relative lack of dissection across the late Pleistocene surface of Dominguez Hills suggests very recent tectonic deformation. However, there is no geomorphic evidence of a through-going fault zone across Dominguez Hills.

The Avalon-Compton fault is a moderately well-defined, N24°W-trending strike-slip fault (figure 3b). The fault is delineated by a moderately well-defined, southwest-facing scarp in late Pleistocene deposits. Additional geomorphic features suggesting latest Pleistocene to Holocene strike-slip displacement include right-laterally deflected drainages, linear troughs in late Pleistocene deposits, closed depressions(?), and associated tonal lineaments (figure 3b). The inferred fault mapped by Poland and others (1959) was only partly verified by this writer along the southeastern part of the fault (figures 2b, 3b). The fault mapped in this study, and verified by Ruff and Hannan (1984), is located from 105 to 210 meters east of the inferred fault zoned in 1976 (figures 2b, 3b).

Recent faulting in the Rosecrans Hills area previously had not been recognized. An inferred west-northwest-trending fault mapped by Ziony and others (1974) (figure 2b) was not verified by this writer. However, short, left-stepping features located between the Avalon-Compton and Potrero faults are consistent with the overall structural fabric of the Newport-Inglewood fault zone (locality 13, figure 3b). Geomorphic features delineating recently active strike-slip faulting are generally only moderately defined along these two inferred faults and could be erosion along a fault or joints in late Pleistocene deposits.

The Potrero fault is delineated by a moderately well-defined, southwest-facing scarp in late Pleistocene deposits that appears to offset a largely preserved terrace surface (figure 3b). Associated geomorphic features indicating latest Pleistocene to Holocene strike-slip displacement (with a normal, down-to-the-west component of displacement) include right-laterally deflected and vertically offset drainages, closed depressions, a linear trough in late Pleistocene deposits, and associated tonal lineaments (figure 3b). The Potrero fault mapped by Poland and others (1959) and Castle (1960) generally was verified by this writer, although differences in detail exist (figures 2b, 3b). Specifically, the cross-faults mapped by Poland and others (1959) and Castle (1960) are not well-defined, and the drainages used to locate the east-northeast-trending faults are not necessarily linear and are more easily explained as drainages in the process of dissecting the southwest-facing Potrero fault scarp. No geomorphic evidence of these cross-faults was observed by this writer southwest of the Potrero fault. No evidence was observed that the Potrero fault is offset by these inferred cross-faults (figure 3b). The Townsite fault of Poland and others (1959) and Kew (1923) generally is not well-defined and could not be verified by this writer except in the vicinity of locality 14 (figure 3b).

The Inglewood fault zone consists of both left- and right-stepping segments generally delineated by moderately well-defined, southwest-facing scarps (figure 3b). Both right-lateral strike-slip and normal displacement during latest Pleistocene and, possibly, Holocene time are suggested by faceted spurs, right-laterally deflected drainages, a possible offset alluvial fan (Holocene ?), and linear drainages (figure 3b). Significant modification of the ground surface by oil field grading had occurred prior to the earliest available air photo coverage (1927), so it is difficult to evaluate the youthfulness of some of these geomorphic features. Also, the fault in the Baldwin Hills is not as well defined in relation to the fault segment just south of the Baldwin Hills. The complex zone of faulting and cross-faults defining the Inglewood fault zone mapped by Castle (1960) and Castle and Yerkes (1976) was not verified by this writer, based on air photo interpretation (figures 2b, 3b). If the northeast-trending faults that are depicted as offsetting segments of the Inglewood fault exist, they are probably minor features because they are not well-defined. Additional north and northeast-trending faults mapped by Castle (1960) and zoned for special studies in 1976 are not well-defined and could not be verified by this writer, based on air photo interpretation (figures 2b, 2c, 3b). Also, the vague tonal lineaments reported by D. Moran (p.c., October 1985) generally were not verified by this writer.

North of the Baldwin Hills, tonal lineaments and a west-facing scarp in Holocene alluvium indicate that the Inglewood fault zone extends north of the Baldwin Hills and is probably Holocene active (figures 3b, 3c). However, the fault mapped by Poland and others (1959) northwestward into the Beverly Hills area was only partly verified by this writer (figures 2c, 3c). Vague tonal lineaments in Holocene alluvium, a broad trough, and east-facing scarp in late Pleistocene alluvium delineate the northern segment of the Inglewood fault zone (figure 3c). North of locality 14 (figure 3c), the fault mapped by Poland and others (1959) could not be verified.

FAULT A

The west-northwest-trending fault near the base of the northern Baldwin Hills mapped by Weber and others (1982) (figure 2b) was generally verified by this writer, although differences in detail exist (figure 3b). The fault generally is moderately well-defined and is characterized by predominantly vertical displacement. A moderately well-defined scarp in an older alluvial fan (Holocene?) indicates possible Holocene activity along the fault (locality 15, figure 3b). Associated geomorphic evidence suggesting recent faulting includes faceted spurs, possible closed depressions, and a trough at the base of a northeast-facing scarp (figure 3b).

FAULT B

The west-northwest-trending fault mapped by Castle (1960) was only partly verified by this writer (figures 2b, 3b). A broad, linear trough in Pleistocene deposits is only moderately defined and geomorphic features along the southeastern projection of this fault were not observed by this writer (figures 2b. 3b).

## SEISMICITY

Seismicity in the study area is depicted in figure 6. A and B quality epicenter locations by California Institute of Technology for the period 1932 to 1984 indicate that no well-defined zone of seismicity can be associated with specific segments of the Newport-Inglewood fault zone (figure 6). Several moderate magnitude earthquakes have occurred along the Newport-Inglewood fault zone, including the June 1920 M4.9 Inglewood earthquake, located west of the Potrero and Inglewood faults, the October 1933 M5.4 earthquake east of Reservoir Hill, and the June 1944 M4.5 and M4.4 earthquakes near Dominguez Hill. Surface fault rupture associated with these seismic events has not been reported (Barrows, 1974).

## CONCLUSIONS

The Newport-Inglewood fault zone is a difficult feature to evaluate in terms of the hazard of surface fault rupture. The conclusions of Harding (1973) assume that the Newport-Inglewood fault zone is characterized by the wrench-tectonic style of deformation. This style of deformation, which Harding considered to be in the early stages of structural development (after Wilcox and others, 1973), is characterized by a complex pattern of generally discontinuous, left-stepping en echelon right-slip faults and associated anticlinal folding. Slip-rate calculations of 0.5 m/yr by Woodward-Clyde Consultants (WCC) (1979) further suggest that the surface expression of traces of the Newport-Inglewood fault zone is probably subtle. However, it is not certain how the late Quaternary slip-rate relates to the late Cenozoic slip-rate calculated by WCC (1979). If the slip-rate has remained relatively constant from late Miocene through late Quaternary time, one should anticipate that the geomorphic expression of individual strands along the Newport-Inglewood fault zone would be only moderately well-defined at best. In addition, the soft, easily-erodable Quaternary rocks and alluvium along the fault zone would not allow the preservation of ephemeral geomorphic features that develop along strike-slip faults.

RESERVOIR HILL FAULT

The Reservoir Hill fault is a moderately well-defined, right-lateral strike-slip fault (figure 3a). The fault mapped by Poland and others (1956) and zoned for special studies in 1976 was generally verified by this writer, although significant differences in location exist (figures 2a, 3a). Geomorphic evidence suggesting latest Pleistocene to Holocene strike-slip faulting includes a northeast-facing scarp with a possible right-laterally deflected drainage, associated linear trough and tonal lineaments (figure 3a). Site-specific fault investigations have verified the location of the Reservoir Hill fault, but have not been conclusive with respect to recency of faulting (see Johnson and Brown, 1984; Rodine and McNamara, 1984; figure 3a, Table 1). Grading has removed evidence of recent faulting at the Johnson and Brown (1984) location (figures 3a, 4) and considerable controversy exists regarding the identification of lithologic units at the Rodine and McNamara (1984) site (figure 3a, Table 1). However, evidence permissive of Holocene displacement was reported along the southeastern continuation of the Reservoir Hill fault by Bryant (1985) (see also Davis, 1981).

NORTHEAST FLANK FAULT

The Northeast Flank fault is only moderately defined by a northeast-facing scarp in late Pleistocene deposits (figure 3a). The fault mapped by Poland and others (1956) and zoned for special studies in 1976 was mostly verified by this writer, although the southeastern extent of the fault mapped by Poland and others was not verified (figures 2a, 3a). Geomorphic evidence of recent faulting, with the exception of a possible right-laterally deflected drainage, was not observed by this writer, although oil field grading had extensively modified the area of the Northeast Flank fault in the early 1920's.

PICKLER FAULT

The Pickler fault was inferred from oil field data and zoned for special studies in 1976, based on mapping by Poland and others (1956) (figure 2a). This fault generally is not well-defined, partly due to oil field grading. This writer did not verify the Pickler fault mapped by Poland and others (1956).

CHERRY HILL FAULT

The Cherry Hill fault is a moderately well-defined, right-lateral strike-slip fault. The fault mapped by Poland and others (1956) and zoned for special studies in 1976 was mostly verified by this writer (figures 2a, 3a). Geomorphic evidence of latest Pleistocene to Holocene strike-slip displacement includes a moderately well-defined, linear southwest-facing scarp in late Pleistocene deposits, a right-laterally deflected drainage, closed depression(?), and associated tonal lineaments (figure 3a). The northwest continuation of the Cherry Hill fault through Dominguez gap is suggested by a wide, northwest-trending zone of vague tonal lineaments in Holocene alluvium (figure 3a). Site-specific investigations along the Cherry Hill fault are generally inconclusive with respect to recent faulting. However, significant deformation of late Pleistocene deposits is indicated, and permissive evidence of recent faulting can be interpreted locally from very generalized trench logs (Scullin, 1979a; Scullin, 1979c; and Cousineau, 1983) (figure 3a, Table 1).

AVALON-COMPTON FAULT

The Avalon-Compton fault is a northwest-trending, right-lateral strike-slip fault with a minor component of down-to-the-southwest vertical displacement (figure 3b; Ruff and Hannan, 1984). The inferred fault mapped by Poland and others (1959) and zoned for special studies in 1976 generally was not verified by this writer (figures 2b, 3b). Associated geomorphic features suggesting Holocene strike-slip displacement include right-laterally deflected drainages, closed depressions(?), linear troughs, and associated tonal lineaments (figure 3b). A site-specific investigation by Ruff and Hannan (1984) verified this writer's location of the Avalon-Compton fault, but prior grading had removed any Holocene soils (figure 3b, Table 1).

FAULTS IN ROSECRANS HILLS

Several short, left-stepping features in the Rosecrans Hills were observed by this writer northwest of the Avalon-Compton fault (figure 3b). These inferred faults are moderately defined and may be formed by erosion along faults or joints in late Pleistocene deposits rather than recent faulting. However, the left-stepping en echelon pattern is consistent with recent strike-slip faulting observed along the Newport-Inglewood fault zone.

POTRERO FAULT

The Potrero fault is a moderately well-defined strike-slip fault with a component of down-to-the-southwest vertical displacement (figure 3b). The fault mapped by Poland and others (1959) and zoned for special studies in 1976 was partly verified by this writer although differences in detail exist (figures 2b, 3b). The Potrero fault is delineated by a partly dissected, southwest-facing scarp in late Pleistocene deposits. Associated geomorphic features permissive of latest Pleistocene to Holocene strike-slip faulting include right-laterally deflected and vertically offset drainages, closed depressions, a linear trough, and associated tonal lineaments (figure 3b). The short, northeast-trending cross-faults mapped by Poland and others (1959) and Castle (1960) are not well defined and were not verified by this writer, based on air photo interpretation (figures 2b, 3b). The Townsite fault mapped by Poland and others (1959) was not verified by this writer, except at locality 14 (figure 3b).

INGLEWOOD FAULT ZONE

The Inglewood fault zone is a relatively complex zone of moderately defined strike-slip and vertical faults (figures 3b, 3c). The complex fault zone mapped by Poland and others (1959) and Castle (1960) was only partly verified by this writer, based on air photo interpretation (figures 2b, 2c, 3b, 3c). Recently active segments of the Inglewood fault zone form both a left- and right-stepping pattern, perhaps indicating complexities related to a more significant vertical component of displacement, based on the more northly trend of the fault zone. Geomorphic features indicating recent faulting along the Inglewood fault zone include southwest-facing scarps in late Pleistocene deposits, right-laterally deflected drainages, faceted spurs, and a scarp and tonal lineaments in Holocene alluvium on the south side of Ballona Creek (figures 3b, 3c). The northwest continuation of the Inglewood fault mapped by Poland and others (1959) and zoned for special studies in 1976 was only partly verified by this writer and is generally not well-defined (figures 2c, 3c). Two site-specific fault investigations by Brown (1980) and Byer (1982) reported no evidence of faulting in late Pleistocene Lakewood Formation (figure 2c, Table 1).

Additional faults in the Baldwin Hills mapped by Castle (1960) and zoned for special studies in 1976 are not well-defined and were not verified by this writer (figures 2b, 2c, 3b, 3c).

Historic creep along north- and northeast-trending faults and fault-like features have been mapped by Castle and Yerkes (1969) and Castle and Yerkes (1976) (figures 2c, 2d). These minor surface rupture events, most noticeably linked to the failure of the Baldwin Hills dam in December 1963 (CDWR, 1964), are thought to be caused primarily by subsidence related to fluid withdrawal (Castle and Yerkes, 1976).

FAULT A

Fault A is a west-northwest-trending fault along the northern front of the Baldwin Hills and is characterized by down-to-the-north vertical displacement (figures 2b, 3b). This fault was zoned for Special Studies in 1976, based on mapping by Castle (1960). Poland and others (1959) (figure 2d) and Weber and others (1982) (figure 2b) also mapped this fault. Weber and others inferred that Holocene alluvium was offset along Fault A (figure 2b). An offset old alluvial fan (early Holocene?) mapped by this writer, based on air photo interpretation (locality 15, figure 3b), partly corresponds with the fault mapped by Weber and others (1982) (figure 2b). Fault A is moderately defined, but may be, in part, modified by erosion.

FAULT B

Fault B was mapped by Castle (1960) as an inferred fault, based on the anomalous location of Pleistocene sands in Ballona gap and lithologic discontinuities based on water-well data. This inferred fault was projected to the southeast as concealed and was zoned for special studies in 1976 (figure 2b). The inferred fault is generally not well-defined and was only partly verified in Pleistocene deposits by this writer (figure 3b). A site-specific investigation by D. Moran did not expose evidence of faulting in Holocene and late Pleistocene alluvium along the southeastern end of this inferred fault (D. Moran, p.c., October 1985).

RECOMMENDATIONS

Recommendations for zoning faults for special studies are based on the criteria of "sufficiently active" and "well-defined" (Hart, 1985).

RESERVOIR HILL FAULT

Zone for special studies traces of the Reservoir Hill fault depicted in figure 7a. Principal references cited should be this FER and Johnson and Brown (1984).

NORTHEAST FLANK FAULT

Zone for special studies those traces of the Northeast Flank fault depicted in figure 7a. Principal references cited should be this FER and Poland and others (1956).

PICKLER FAULT

Zone for special studies only those traces that are well-defined as depicted in figure 7a. Delete traces of the Pickler fault originally zoned for special studies in 1976.

CHERRY HILL FAULT

Zone for special studies traces of the Cherry Hill fault depicted in figure 7a. Principal references cited should be Poland and others (1956) and this FER.

AVALON-COMPTON FAULT

Zone for special studies traces of the Avalon-Compton fault depicted in figures 7b and 7c. Principal references cited should be this FER and Ruff and Hannan (1984).

FAULTS IN ROSECRANS HILLS

Zone for special studies traces of faults in the Rosecrans Hills depicted in figure 7c. Principal reference cited should be this FER.

POTRERO FAULT

Zone for special studies traces of the Potrero fault depicted in figure 7c. Principal reference cited should be this FER.

INGLEWOOD FAULT ZONE

Zone for special studies traces of the Inglewood fault zone depicted in figures 7c, 7d, and 7e. Include those features along which historic surface rupture has occurred. Principal references cited should be Castle and Yerkes (1976) and this FER.

FAULT A

Zone for special studies traces of Fault A depicted in figure 7c. Principal reference cited should be this FER.

FAULT B

Delete traces of Fault B. This fault is neither sufficiently active nor well-defined.

Air photos checked and report reviewed. I agree with recommendations.
Earl W. Hart
11/22/85

William A. Bryant

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Associate Geologist
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November 15, 1985

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TABLE 1 - Summary of Selected Consulting Reports
Filed with DMG

| Consulting Report Project No. DMG file No. | Fault Investigated | Fault Located ? | Recency Established | Remarks |
|---|---|---|---|---|
| LONG BEACH QUADRANGLE | | | | |
| Allen (May 1977) AP-1639 | Cherry Hill fault | No | N/A | Two trenches (240') excavated to depth of 8' to 9'. No evidence of faulting reported in late Pleistocene terrace deposits. A slight monoclinal warp in late Pleistocene deposits is suggested in trench B, indicating down-to-SW direction. However, trench logs are extremely generalized. |
| Brown, Van Beveren and Kirkgard (Nov. 1980) AE--80322 AP-1601 | Cherry Hill fault | No | N/A | Two trenches totaling 164' excavated to depths of about 10'. No evidence of faulting reported in trenches. Faulting in late Pleistocene deposits is weakly suggested in trench 2 at Sta. 95 where a down-to-the-SW flexure is suggested. However, this is weak evidence for faulting. |
| Cousineau (July 1978) 140-078 AP-1575 | Cherry Hill fault | No | N/A | One 170' long trench excavated. Artificial fill from 3' to 6' thick encountered. Trench averaged 9' to 10' deep. No faulting reported. |
| Cousineau (April 1983) 1094-043 AP-1540 | Cherry Hill fault | No | N/A | One trench (115') excavated to depth of 10'. No evidence of faulting reported. However, contacts of units parallel ground surface, which has an apparent slope of $12^{o}$-$14^{o}$ to the south. Units identified were pre-Holocene terrace deposits. Some amount of tectonic deformation is indicated by apparent dip of deposits. |

| Consulting Report<br>Project No.<br>DMG file No. | Fault Investigated | Fault Located ? | Recency Established | Remarks |
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| LONG BEACH QUADRANGLE | | | | |
| Earnest & Nevin(June 1978)<br>584G<br>AP-1576 | Cherry Hill fault | No | N/A | Two trenches totaling 295', average depth 9' (locally 20'). No evidence of faulting reported in late Pleistocene terrace deposits. Trench T-1 apparently crossed mapped trace of fault. Consultant stated that bedding plane attitudes were not discernible in trenches. Thus, deformation cannot be ruled out based on this information. A petroliferous sand deposit severely caved and perhaps obscured evidence of faulting. This sand unit pinches out to the SW, and is perhaps offset. |
| Evans (June 1977)<br>77-71<br>AP-589 | Cherry Hill fault | No | N/A | Two trenches totaling 90' excavated to depths of 8' to 12'. No evidence of faulting reported. Trenches very close to mapped trace of southern end of Cherry Hill fault. Based on my interpretation of photos, fault does not extend this far southeast. |
| Johnson and Brown<br>(Oct. 1975)<br>E-75197<br>AP-451 | Reservoir Hill fault | No | N/A | Two trenches totaling 350' excavated to depths of 7' to 12'. No evidence of faulting found. Trenches crossed mapped trace of fault. However, it is probable that fault is located west of site. Thick fill encountered in most of exposures - no indication of structure and bedding provided in trench logs. |

| Consulting Report Project No. DMG file No. | Fault Investigated | Fault Located ? | Recency Established | Remarks |
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| LONG BEACH QUADRANGLE | | | | |
| Johnson and Brown (March 1984) AE-84016 AP-1681 | Reservoir Hill fault | Yes | late Pleisto-cene | Evidence of major faulting located in trenches 1, 3, 5. San Pedro Fm. on west faulted against Lakewood Fm. on east. Surface had been graded, so young deposits overlying Lakewood Fm. have been removed. Consultant stated that youngest deposits may be 15,000 yr. old. Zone is as wide as 60' in T-1. Setbacks were recommended. Fault was located as much as 180' SW of mapped trace of fault (1976 SSZ map). Consultant concluded fault was normal, although principal fault oriented from N55°W 87°SW to N36°W 86°NE. Subsidary or branch fault is SW-dipping reverse fault. Magnitude of offset could not be determined. It is probable that fault is significant r.l. strike-slip fault with component of down-to-east normal faulting. Evidence of liquefaction reported, including sand dikes and sand boils. |
| Merrill (July 1976) 63427 AP-262 | Cherry Hill fault | No | N/A | 1 trench 5' deep excavated - no fault reported in trench- trench much too shallow to account for any faulting of late Holocene floodplain deposits. |
| Merrill (July 1976) 63480 AP-1643 | Cherry Hill fault | No | N/A | Two trenches excavated, no evidence of faulting reported (Logs not in report). |

| Consulting Report Project No. DMG file No. | Fault Investigated | Fault Located ? | Recency Established | Remarks |
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| LONG BEACH QUADRANGLE | | | | |
| Merrill (Aug. 1977) 74021 AP-707 | Reservoir Hill fault | No | N/A | One trench 590' long about 10' deep excavated. Consultant observed fault in natural exposure (?) where terrace deposits(?) are faulted (fault att. N33°W76°NE). Fault trace projected across trench on location map, but trench log does not show evidence of fault. Consultant stated that soil was not offset by fault, but this has not been documented in report. |
| Merrill (April 1978) 84444 AP-1579 | Cherry Hill fault | No | N/A | Two trenches excavated. No logs provided in report. Consultant stated that no faults were observed. |
| Rodine & McNamara (1985) C-606 | Reservoir Hill fault | Yes | latest Pleistocene | Fault located and trends diagonally across property. Zone of faults located. Trend of principal fault N38°W to N40°W, with vertical dip. Fault offsets latest Pleistocene Lakewood Fm., but controversy exists as to youngest unit not faulted. Consultant reported that uppermost Lakewood Fm. is not offset by fault, concluded that fault is not active and recommended that no building setback be established. City of Long Beach geologist, D.D. Clarke observed excavations and concluded that fault offsets all natural units (latest Pleistocene), and contends that youngest unit not faulted is artificial fill. Logs of exploration trenches do not support consultants conclusion that latest Pleistocene deposits are not offset. Thus, fault probably offsets all natural deposits, but recency was not established due to prior grading. |

| Consulting Report<br>Project No.<br>DMG file No. | Fault<br>Investigated | Fault<br>Located ? | Recency<br>Established | Remarks |
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| LONG BEACH QUADRANGLE | | | | |
| Scullin (July 1976)<br>G76160<br>AP-276 | Cherry Hill fault | No | N/A | One 118'-long trench excavated to 11' depth. Artificial fill ranged from 3' to 11' thick. |
| Scullin (Feb. 1977)<br>77117<br>AP-388 | Cherry Hill fault | No | N/A | Trench may have crossed mapped trace of fault, but location "map" is only an approximate sketch. Trench was 100' long and locally, 12' deep. Thick articicial fill (up to 10' thick) reported. Log of trench generally inadequate to document evidence for or against presence of subtle features that may indicate faulting. |
| Scullin (Jan. 1978)<br>78102<br>AP-644 | Reservoir Hill fault | No | N/A | One trench 73' long excavated to depth of 7'. No faulting reported in Pleistocene deposits. Trench apparently did not cross mapped trace of Reservoir Hill fault. |
| Scullin (Jan. 1979)<br>79106<br>AP-1572 | Cherry Hill fault | Yes | latest Pleisto-cene to Holocene (?) | Six tenches excavated to depths averaging 10' deep. Faults reported in trenches T-2 and T-6 offset unit identified as Palos Verdes sand ($Qt_3$) Overlying terrace deposit ($Qt_1$) reportedly not offset. However, old erosion surface identified between $Qt_3$ and $Qt_1$ in T-2 is deformed, suggesting tectonic deformation. Beds in $Qt_3$ dip 25°SW NE of fault and 45°SW SW of fault. Schlemon in an investigation just south of the site, identified a 10,000-20,000 yr. paleosol that is probably $Qt_1$. Thus, tectonic deformation may be latest Pleistocene to early Holocene. |

| Consulting Report<br>Project No.<br>DMG file No. | Fault<br>Investigated | Fault<br>Located ? | Recency<br>Established | Remarks |
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| LONG BEACH QUADRANGLE | | | | |
| Scullin (March 1979)<br>79110<br>AP-1578 | Northeast Flank fault | No | N/A | One trench (100') excavated to depth of 6' to 9'. No evidence of faulting reported. |
| Scullin (April 1979)<br>79123<br>AP-1697 | Cherry Hill fault | Yes | latest Pleisto-cene | Two trenches excavated to depths to 9'. Trenches located east of mapped trace of fault, in upthrown side. Consultant reported no evidence of recent faulting, specifically that minor faults didn't cut younger terrace deposits. However, no younger terrace deposits ($Qt_1$) where across faults. The most significant aspect of trench exposures was the deformation of the late Pleistocene terrace deposits. At the northeast end of trench beds dipped 15°SW & near the SW end of the trench the dip steepened to 45°SW, which was nearly coincident with the scarp-slope. This structure strongly indicates significant deformation of a up-on-the-east reverse oblique fault. The small shears reported in the two trenches probably related to deformation on up-throw side of reverse fault. |
| Scullin (Dec. 1982)<br>82128<br>AP-1613 | Cherry Hill fault | No | N/A | Two trenches excavated to 7' to 9'. No evidence of faulting reported. Thick fill to 6' encountered. |
| Scullin and Simon (March 1985)<br>2279-01<br>C-605 | Reservoir Hill | possibly | possibly historic | Clay and sand-filled fractures reported in pre-1933 artificial fill. Fractures align with regional trend of Reservoir Hill fault and have N43°W 80°-90°SW altitude. In deep trench excavations, it was reported that frac-tures are continuous, linear features for a distance of at least 30 meters. Trench T-5, deepened in order to expose natural materials, |

| Consulting Report<br>Project No.<br>DMG file No. | Fault Investigated | Fault Located ? | Recency Established | Remarks |
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| Scullin and Simon (contd) | | | | apparently did not have evidence of faulting in bedrock. However, excavation caved in natural deposits where faulting was anticipated, thus precluding detailed examination of exposures. Consultant concluded that fractures in pre-1933 fill were formed either by seismic shaking associated with 1933 Long Beach earthquake or differential settlement cracks; not surface fault rupture features. |
| INGLEWOOD QUADRANGLE | | | | |
| Byers (March 1979)<br>KB4363-S<br>AP-983 | NE-trending cross fault-Inglewood fault zone | No | N/A | One trench (160', 7' deep) excavated, no evidence of faulting reported. |
| Cousineau (Oct. 1980)<br>670-100<br>AP-1282 | Inglewood fault | No | N/A | Two trenches totaling 407' (6' to 11' deep). No evidence of faulting reported. Trenches excavated just west of inferred fault trace. |
| Cousineau (Jan. 1982)<br>915-012<br>AP-1454 | Inglewood fault | No | N/A | One trench (150' long, 8' deep) excavated just west of inferred fault trace. No evidence of faulting reported. |
| Cousineau (Feb. 1982)<br>928-022<br>AP-1433 | "Cemetery" fault (NE-trending cross fault) | No | N/A | One trench (60' long, 8' deep) excavated just north of inferred fault. No evidence of faulting reported. |
| Harter and Kirkgard (Feb. 1985)<br>3191-52<br>AP-1769 | Inglewood fault | No | N/A | One trench (130' long, 6' deep) excavated. No evidence of faulting reported. Deposits are late Pleistocene terrace deposits with moderately developed pedogenic B-soil horizon. |
| Howe and Payne (May 1984)<br>S-0853-E<br>AP-1719 | Inglewood fault | No | N/A | One trench (120' long, 5' to 6' deep) excavated; no evidence of faulting reported. Trench exposed late Pleistocene terrace deposits (Lakewood Fm.). Well-developed argillic B-soil horizon developed on terrace |

| Consulting Report<br>Project No.<br>DMG file No. | Fault Investigated | Fault Located ? | Recency Established | Remarks |
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| INGLEWOOD QUADRANGLE | | | | |
| Howe and Payne (contd) | | | | deposits; clay skins on ped. surfaces. Consultant estimated that terrace deposits greater than 10,000 yr.old, perhaps as old as 100,000 ybp. Also, it was estimated that B horizon was thicker than depth of trench. |
| Hu and Cousineau (July 1980)<br>HA1070-4<br>AP-1223 | Townsite fault | No | N/A | One trench 67' long, 7' deep excavated just west of inferred fault-No evidence of faulting reported. |
| Larson & Yoakum (Jan. 1981)<br>966-VN<br>AP-1283 | Potrero fault; NE-trending cross fault | No | N/A | Trenches excavated to 12' deep, no evidence of faulting reported. Trend STP-1 crossed inferred trace of Potrero fault. No apparent offsets-two features described as "staining" had measurable trends-N19°W 85°E and N69°E 89°N. These features occurred at topographic base of west-facing slope-additional "stains"-fracture with iron and manganese staining, located to the west with trends from N18°W to N8°E, all are near vertical. No bedding att. mentioned for terrace deposits-logs generalized. No evidence of faulting reported for NE-trending cross-fault. |
| Lass & Eagen (Nov. 1978)<br>178-122<br>AP-874 | NE-trending cross fault-Inglewood fault zone | No | N/A | About 775' of trenching excavated to depths from 5' to (locally) 10' deep. No evidence of faulting reported. Air photo interpretation by consultants stated no geomorphic evidence of recent fault west of Inglewood fault. |
| Lockwood & Singh (Oct. 1978)<br>BZ5-72<br>AP-888 | NNE-trending fault in Baldwin Hills | No | N/A | One trench excavated, no evidence of faulting reported. No trench log included in report. |

| Consulting Report Project No. DMG file No. | Fault Investigated | Fault Located ? | Recency Established | Remarks |
|---|---|---|---|---|
| **INGLEWOOD QUADRANGLE** | | | | |
| Merrill (Feb. 1977) AP-398 | NE-trending "earth crack" | Yes | Holo-cene(?) | Minor faulting re-activated by oil field operations produced surface deformation east and west of site. Minor faulting reported in trench apparently doesn't cut soil (graphic log not included in report). Soil is probably late Holocene colluvium. |
| Merrill (Sept. 1979) 95003 AP-1028 | Avalon-Compton | No | N/A | One trench 600' long excavated to depths of 5' to 14' deep. No evidence of faulting reported in late Pleistocene alluvium. However, near-vertical contact between gravel on west and sand on east at Sta. 3 + 60 suggests faulting. Site has been extensively altered by grading. |
| Munson (March 1981) AP-1328 | Inglewood fault | No | N/A | One 95' long, 6' to 7' deep trench excavated across inferred fault trace. No evidence of faulting reported. Soil-filled fissures in late Pleistocene Lakewood Fm. incorporated overlying soil-some fractures extended up into soil horizon (thick B?). Consultant concluded fractures were relict dessication cracks-slickensided surfaces reported on the fracture surface, but no indication of orientation of slickensides. |
| Munson (Feb. 1983) AP-1536 | Inglewood fault | Yes | latest Pleisto-cene | Minor fault offsets late Pleistocene Lakewood Fm. (flt.att. N-S, 80°W)-magnitude of offset not known-overlying soil doesn't appear to be offset. |
| Rinne and Johnson (May 1980) 10711-001-02 AP-1159 | Short, NW-trending fault along E. side of Baldwin Hills | No | N/A | One 250' long trench excavated to depth of about 10'. No evidence of faulting reported. Geophysical survey (seismic reflection) by Gasch & Assoc. reported no evidence of near-surface faulting. |

| Consulting Report<br>Project No.<br>DMG file No. | Fault<br>Investigated | Fault<br>Located ? | Recency<br>Established | Remarks |
|---|---|---|---|---|
| INGLEWOOD QUADRANGLE | | | | |
| Ruff and Hannan<br>(April 1984)<br>83-02218-02<br>AP-1814 | Avalon-Compton fault | Yes | late Pleisto-cene | Principal trace of Avalon-Compton fault exposed in two trenches. Site formerly had been dump site, so natural soils have been disturbed or removed. Principal fault att. N20°W 90°-small drag folds in beds indicate down-to-the-west component of vertical offset which is consistent with the west-facing scarp associated with the fault. Slickensides along westernmost fault indicate horizontal and oblique slip. Fault zone exposed in trench T-5 is about 55' wide. Deposits offset are late Pleistocene Lakewood Fm. Holocene displacement was not demonstrated due to removal of overlying soils, but also cannot be ruled out. Major stratigraphic discontinuity across principal fault trace reported in both trench T-5 and bore-hole data. Setback recommended. |
| Schrenk & Howser<br>(May 1978)<br>AP-777 | NE-trending cross fault-Inglewood fault zone | Yes | Pleisto-cene | Minor faults offseting early Pleistocene San Pedro Fm. Offsets ranged from 1/2" to 6", overlying soil removed by grading. Although no evidence for recency observed, building setback of 10' recommended. |
| Scullin (Oct. 1981)<br>81154<br>AP-1400 | Inglewood fault | No | N/A | One trench (125' long, 12' to 14' deep) excavated across inferred trace. No evidence of faulting reported in late Pleistocene Lakewood Fm. |
| Shmerling & Robinson<br>(Jan. 1978)<br>5702<br>AP-688 | NE-trending cross fault-Inglewood fault zone | No | N/A | Three trenches totaling 100 feet excavated to depths of 6' to 13'. No evidence of faulting reported in alluvial deposits. |

| Consulting Report<br>Project No.<br>DMG file No. | Fault<br>Investigated | Fault<br>Located ? | Recency<br>Established | Remarks |
|---|---|---|---|---|
| INGLEWOOD QUADRANGLE | | | | |
| Tucker & Tousa<br>(Sept. 1983)<br>2127-83<br>AP-1619 | Potrero fault | No | N/A | Trenches excavated to 6' to 8' deep in late Pleistocene Lakewood Fm. No evidence of faulting reported. However, contacts between units of Lakewood Fm. nearly parallel SW-facing slope, indicating that they may be tectonically deformed. Consultant stated that fault, based on geomorphic evidence, is located 200' to 240' west of the site. |
| HOLLYWOOD QUADRANGLE | | | | |
| Clements (Jan. 1979)<br>AP-918 | NW-trending fault along base of Baldwin Hills | No | N/A | Two trenches excavated from 5' to 8' deep. No evidence of faulting reported. Bedding att. N20°W 20°NE in Plio-Pleistocene shale and sandstone. |
| Clements (May 1980)<br>AP-1206 | NE and NW-trending "earth cracks" in Baldwin Hills | Yes | Historic | Cracks in Palos Verdes sand extend into artificial fill-cracks have trends ranging from N25°E to N20°W-cracks related to oil field subsidence. Cracks do not seem to displace bedding, but trench log is highly generalized. |
| Lung (June 1977)<br>77125-1<br>AP-502 | NW-trending feature NE of Baldwin Hills | No | N/A | One trench (193') excavated to 5' deep in Holocene alluvium. No evidence of faulting reported. |
| Merrill (April 1978)<br>84392<br>AP-812 | NW-trending fault along base of Baldwin Hills | No | N/A | Four trenches excavated, no evidence of faulting reported. |
| Merrill (May 1978)<br>84393<br>AP-844 | NNE-trending fault in Baldwin Hills | Yes | Historic<br>(?) | Minor fault NNE-trending with 70°W dip offsets Inglewood Fm. approx. 1" (down to west) and offsets Holocene soil (colluvium?). This feature is probably related to oil field subsidence. |

| Consulting Report<br>Project No.<br>DMG file No. | Fault Investigated | Fault Located ? | Recency Established | Remarks |
|---|---|---|---|---|
| HOLLYWOOD QUADRANGLE (contd) | | | | |
| Munson (Jan. 1981)<br>AP-1262 | Short NW-trending fault | Yes | pre-Holocene | Several shears in Plio-Pleistocene(?) sedimentary rocks-overlying colluvium not offset Consultant considered faults normal with from 0.5' to 2' of displacement. |
| Robinson (Dec. 1978)<br>0185<br>AP-940 | NW-trending fault in northeastern Baldwin Hills | No | N/A | Three trenches excavated in Pleistocene San Pedro Fm.-no evidence of faulting reported. |
| Tucker (Feb. 1979)<br>223-79<br>AP-977 | NW-trending fault along base of Baldwin Hills | No | N/A | Two trenches (130') excavated from 3' to 5' deep in Pleistocene San Pedro Fm. No evidence of faulting reported. Bedding in San Pedro Fm. near horizontal. |
| BEVERLY HILLS QUADRANGLE | | | | |
| Brown (May 1980)<br>ADE-80099<br>AP-1229 | Beverly Hills segment Inglewood fault | No | N/A | One 100' long, 10' deep trench excavated across inferred fault trace. Apparent NE-facing scarp (break in slope) underlain by continuous deposits identified by consultant as late Pleistocene Lakewood Fm. No evidence of faulting reported. |
| Byer (Feb. 1982)<br>KB6656-S<br>AP-1631 | Beverly Hills segment Inglewood fault | No | N/A | Two trenches totaling 136' to depths from 7' to 11'. Trenches excavated across NE-facing scarp. No evidence of faulting reported. Alluvium (colluvium?) in trench exposure deposited across escarpment. However, trenches not deep enough to adequately expose Lakewood Fm. at scarp. Thus, not clearly established whether scarp erosional or due to faulting. |

| Consulting Report<br>Project No.<br>DMG file No. | Fault<br>Investigated | Fault<br>Located ? | Recency<br>Established | Remarks |
|---|---|---|---|---|
| BEVERLY HILLS QUADRANGLE (contd) | | | | |
| Eagen (Aug. 1975)<br>475-28<br>AP-196 | Projected trend of unnamed fault in Baldwin Hills | No | N/A | Five trenches excavated. No faults reported in deposits assumed to be Holocene fluvial deposits. |
| Fisher (March 1981)<br>81001-2<br>AP-1286 | Beverly Hills segment Inglewood fault | No | N/A | One test pit (14') excavated to 14' deep in Holocene(?) alluvium. Trench excavated about 50'-100' E. of mapped (concealed) trace. No evidence of faulting reported, although exposure not adequate to rule out faulting near site. |
| Shubeck and Schrenk (March 1984)<br>AP-1678 | Beverly Hills segment Inglewood fault | No | N/A | One 129' long trench excavated to 10' deep. No evidence of faulting reported in Holocene alluvium. |

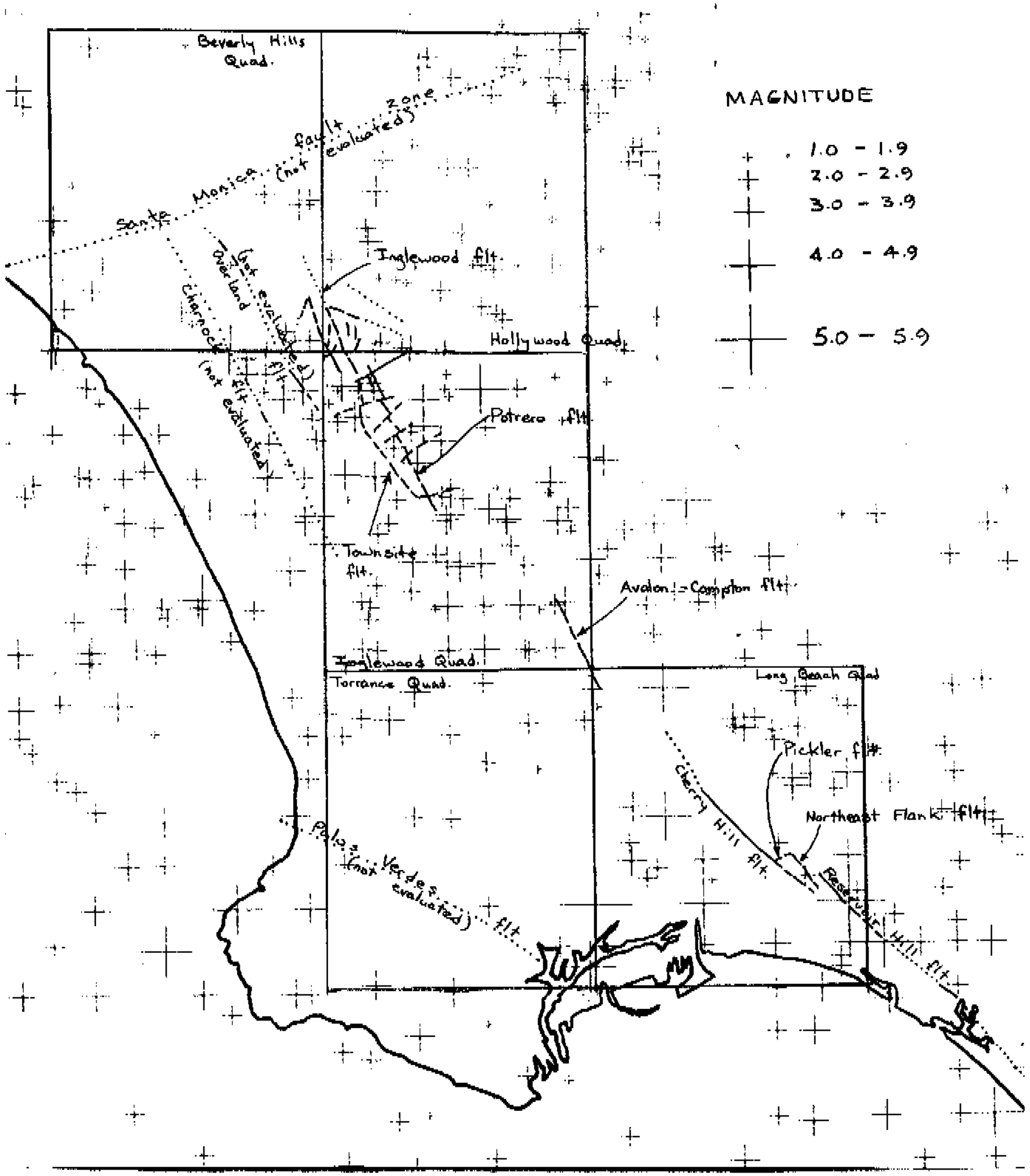


Figure 6 (to FER-173). Seismicity (A and B quality) in the study area for the period 1932 to 1984, based on locations from California Institute of Technology. Faults are from Jennings (1962) and Jennings and Strand (1969).